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BICYCLE-MOTOR VEHICLE ACCIDENTS IN THE BOSTON METROPOLITAN REGION

A Study of Reported Accidents Occurring Within Route 128 in 1979 and 1980

GOVERNMENT DOCUMENTS
COLLECTION

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Area
Planning
Council
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April, 1984

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Abstract

The Metropolitan Area Planning Council, the regional planning agency for the Boston metropolitan area, studied bicycle-motor vehicle accidents occurring within Route 128, a major beltway encircling 35 communities. A sample of one of every four accidents reported to the Massachusetts Registry of Motor Vehicles in 1979 and 1980 was chosen for review. Data were collected by a paid intern and by six volunteers who reviewed bicycle accidents occurring within their individual communities. This sampling technique resulted in a distribution of accidents by month and location statistically almost identical with the distribution for all accidents in the study area.

The accidents were classified using a modified version of the classification system developed by Kenneth Cross. The highest frequency accident class involved a motorist turning right or left at an intersection and hitting a bicyclist coming from behind or from the opposite leg of the intersection. Virtually as frequent was a motorist entering an intersection and striking a cyclist emerging from the orthogonal leg. These accidents occurred primarily among cyclists over 18 years of age. "Bicycle ride-out" accidents where the cyclist entered the road at a mid-block location also occurred with some frequency, particularly among children younger than 11 years of age.

Frequencies on key variables such as time of accident were also obtained.

Recommendations include publicity of the study results;education of bicyclists and motorists; increased enforcement of traffic laws; and improved record-keeping for ongoing classification of bicycle-motor vehicle accidents.

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I. INTRODUCTION

In 1982, in response to the Environmental Protection Agency's request for the development of "reasonably available control measures" (RACMs) to reduce air pollution in the Boston metropolitan area, the Metropolitan Area Planning Council developed two projects to increase the use of bicycles for commuting in its area (1). One of these projects was a study of bicycle-motor vehicle accidents in the Boston area, patterned after the Cross-Fisher study completed in 1977 and the Missoula, Montana study of 1981 (2). The purpose of the study was to identify the most common types of accidents occurring in the MAPC region, and to develop a set of countermeasures to reduce the frequency of these accidents.

Several studies and articles had previously suggested the importance of fear for safety as a major deterrent against bicycle commuting (3). It was expected that the study would result in the implementation of recommendations for education and increased enforcement, and directly reduce the number of accidents in the region. In addition, publicity about the study's findings could be used to increase motorists' and bicyclists' awareness about the most frequent accident classes and thereby motivate them to take actions to prevent their occurrence. Ultimately, it was hoped that these measures would result in the increased use of bicycles for commuting, and a concomitant decrease in auto-generated pollution.

In choosing to carry out this study, MAPC was aware of the limitations of the methods used - review of police and operator accident reports. As has been pointed out in other studies of this type, only a fraction of bicycle-motor vehicle accidents which occur are formally reported. Cross estimated that, between 1972 and 1977, about 1,000 fatal and 40,000 non-fatal bicycle-motor vehicle accidents across the country were reported to police, while another 40,000 injury-producing accidents went unreported.(4).

Still, without an extraordinary effort being put forth, these reports provide the best consistent source of information about bicycle-motor vehicle accidents. Another suggested source of data is hospital records. The forms used would not be standardized and would include only the most serious accidents. They would also lose the advantage of involving the police in the study. It is beneficial for police to be involved, as any recommendations for improved enforcement will largely rely on the police for implementation. Another possible benefit is that use of these forms for research purposes will encourage police, motorists and bicyclists to complete them with greater attention to the quality of description. Currently, the quality of data is mediocre.

Methodology

The study was carried out between November, 1982 and June, 1983. Data from police and operator reports of bicycle-motor vehicle accidents occurring in 1979 and 1980 were obtained by:

1) a paid intern reviewing microfilm of accident reports at the state's Registry of Motor Vehicles; and
2) volunteers reviewing actual reports of accidents at six local police departments.

The area within Route 128, a major beltway in the region encompassing 35 cities and towns including Boston and Cambridge, was chosen for the study (see Figure 1). As almost 2,000 accidents had been reported for 1979 and 1980, it was decided to study a sample of the reported accidents.

Metropolitan
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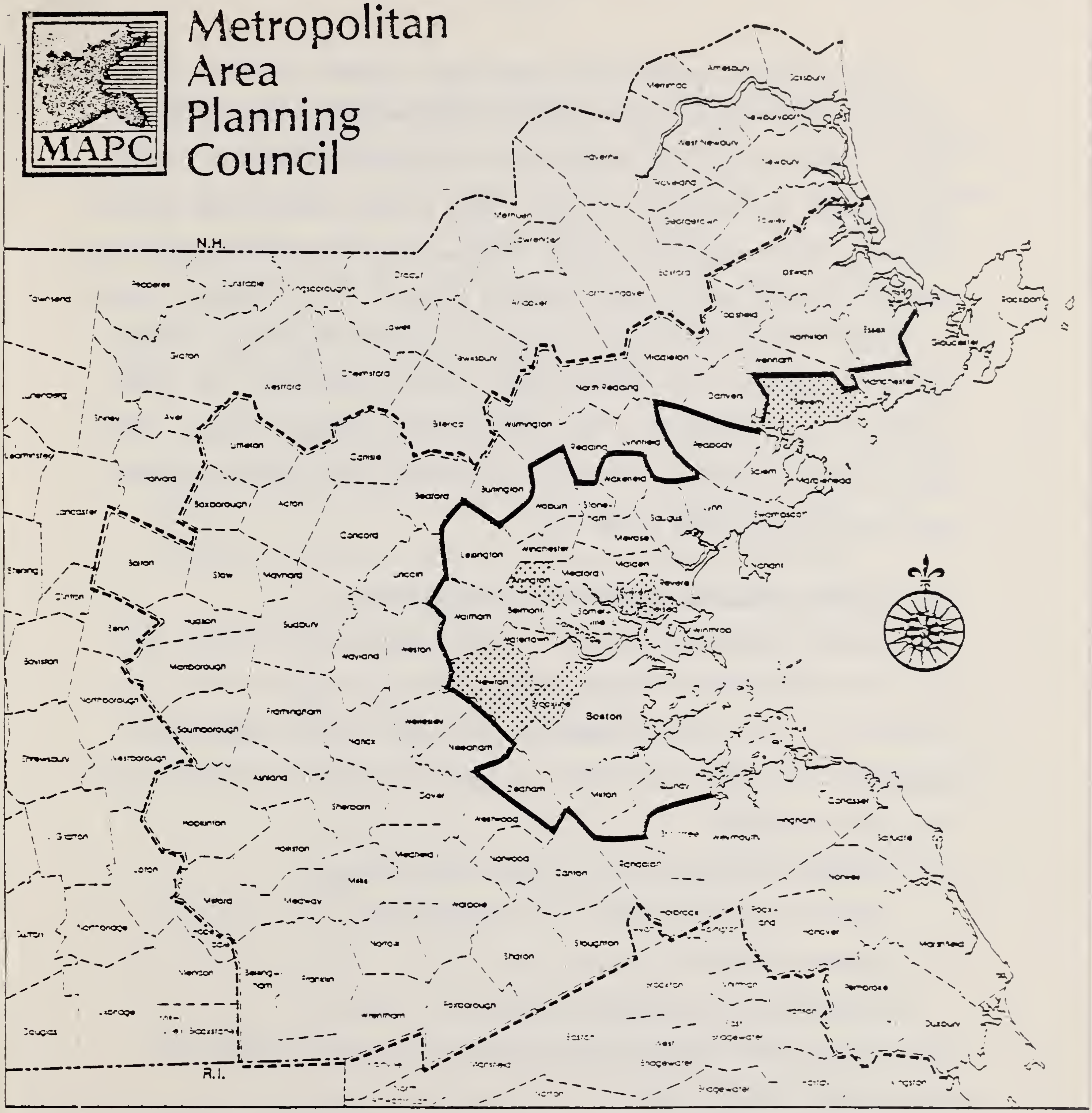


Bicycle Accident Study
1983

---- MAPC Boundary

4 2 0 4 8 12
Scale in Miles

▬ Study Area Boundary

▨ Data collected at local police departments.

Data for all other cities & towns was obtained from the Massachusetts Registry of Motor Vehicles.

FIGURE

WP/DW

The selection of accidents was done using a computer print-out provided by the Massachusetts Department of Public Works of all bicycle-motor vehicle accidents occurring in the study area during 1979 and 1980. One in four accidents was selected for review. When accident reports were found to be missing from the Registry of Motor Vehicles or the local police department, additional reports were selected from this printout. This procedure resulted in a sample of 516 reports (5). Of these, 87 provided insufficient information for accident classification purposes, and were included in the results only for purposes of examining other variables such as month of year, time of day and weather conditions. In total, 429 accidents were classified using a modification of the Cross scheme (6).

The MAT Classification Scheme and MAPC Revisions

The Manual Accident Typing (MAT) scheme prepared by the National Highway Traffic Safety Administration (NHTSA) in 1982 was used to classify the accidents (7). This scheme is based upon the classification system created by Kenneth Cross in his 1977 study. This system classified accidents according to four variables -

- Pre-collision direction of travel of each operator
- Relative pre-crash motion of the two vehicles
- Operator errors
- Characteristics of accident location

In his study, Cross created 36 types (Types 1-36) which he grouped into seven classes (Classes A-G).

The MAT added eight types to the Cross classification system, and fitted these into Classes A-G.

MAPC revised the MAT scheme slightly. It removed accident Type 27 "Cyclist Overtaking" from Class G and Type 35, "Drive-Out: On-Street Parking" and Type 41, "Cyclist Strikes Parked Vehicle" from the MAT's two miscellaneous classes to create a new class labeled "Class G(Revised): Slowed or Parked Car." It was believed that the accident types in this class represent a distinct set that may be addressed by specific distinct countermeasures. "Other" or "Weird" accident types were combined into a "Class H (Revised): Other". The MAT system separated these latter two groups. In all other respects, the MAPC classification scheme is similar to the MAT system (8).

Below is a list of the nine classes used in the MAPC system:

- Class A: Bicycle Ride-Out at Driveway, Alley or Mid-Block
  Involve a bicycle emerging from a driveway, alley or other mid-block location (such as over a shoulder or curb) and colliding with a motor vehicle.
- Class B: Bicycle Ride-Out at Intersection
  Involve a bicycle emerging at an intersection and proceeding straight across the intersection. (Accidents involving bicycles making right or left turns are included in Class E.)
- Class C: Motorist Driveout
  Involve a motor vehicle emerging from a mid-block location (driveway, alley) or an intersection, thus paralleling Classes A and B. Only motor vehicles proceeding straight across the intersection or turning right on red are included in this class. (Accidents involving motorists making right- or left-turns are included in Class F).

- Class D: Motorist Overtaking/Overtaking Threat

  Involve a motor vehicle approaching from behind and colliding or almost colliding with a bicycle.

- Class E: Bicyclist Unexpected Turn/Swerve

  Involve a bicycle making a left- or right- turn at an intersection or swerving mid-block into the path of an overtaking or approaching motor vehicle. Excluded are accidents where the bicylist swings too sharply or too widely and collides with a motor vehicle on the perpendicular leg of the intersection, which are included in Class H: Other.

- Class F: Motorist Turn

  Involve a motorist who is turning right or left at an intersection and collides with a motor vehicle approaching from behind or from the opposite leg of the intersection. Excluded are accidents where the motorist turns right on red (included in Class C: Motorist Driveout) or where the motorist cuts left-hand turn (included in Class H: Other).

- Class G: (Revised) Slowed or Parked Cars

  Involve a bicyclist overtaking and colliding with a motor vehicle that is slowed in traffic, parked, or entering or exiting parking. As mentioned above, this class was created by MAPC, and was not included separately in the Cross or Missoula studies or NHTSA's MAT system.

- Class H: (Revised) Other

  Involve unrelated accidents that do not fall under any of the above classes. This class, therefore, cannot be analyzed as a class in terms of specific countermeasures; each of the types must be assessed individually. This class differs from the Cross, Missoula and NHTSA's MAT system.

II. RESULTS OF STUDY - DESCRIPTION OF SAMPLE

A. Year of Accident (n=516) (9).

Of the 516 accidents, 45 percent occurred in 1979 and 55 percent in 1980 (10).

B. Month of Year (n=513)

The majority of accidents occurred during the summer months, from June through August (54 percent). This is consistent with statistics provided by the Massachusetts Department of Public Works for the MAPC region as a whole (see Figure 2). Although no information on comparative ridership exists for the study area, the report Bicycle-Traffic Volumes in Metropolitan Boston, covering primarily Boston and its immediate neighbors, shows a less steeply peaked distribution (11). The difference may be due to a higher proportion of children in the study area relative to the area in which bicycle counts were undertaken. In this case, it is assumed that children are more likely to ride in summer and to have accidents. Additional work is necessary to determine the relationship between accident counts and ridership.

The accidents in the MAPC study showed a greater tendency to cluster during the summer months than in the Cross study (p. 117), which included two cities with year-long moderate weather in the sample.

C. Day of Week (n=512)

Accidents were more likely to occur on weekdays, with Friday being the highest frequency day (17 percent) and Sunday the lowest frequency day (10 percent). Figure 3 displays these results. This is consistent both with the MAPC region and the Cross study (p.112). This variable was not studied in Bicycle-Traffic Volumes in Metropolitan Boston.

Figure 2

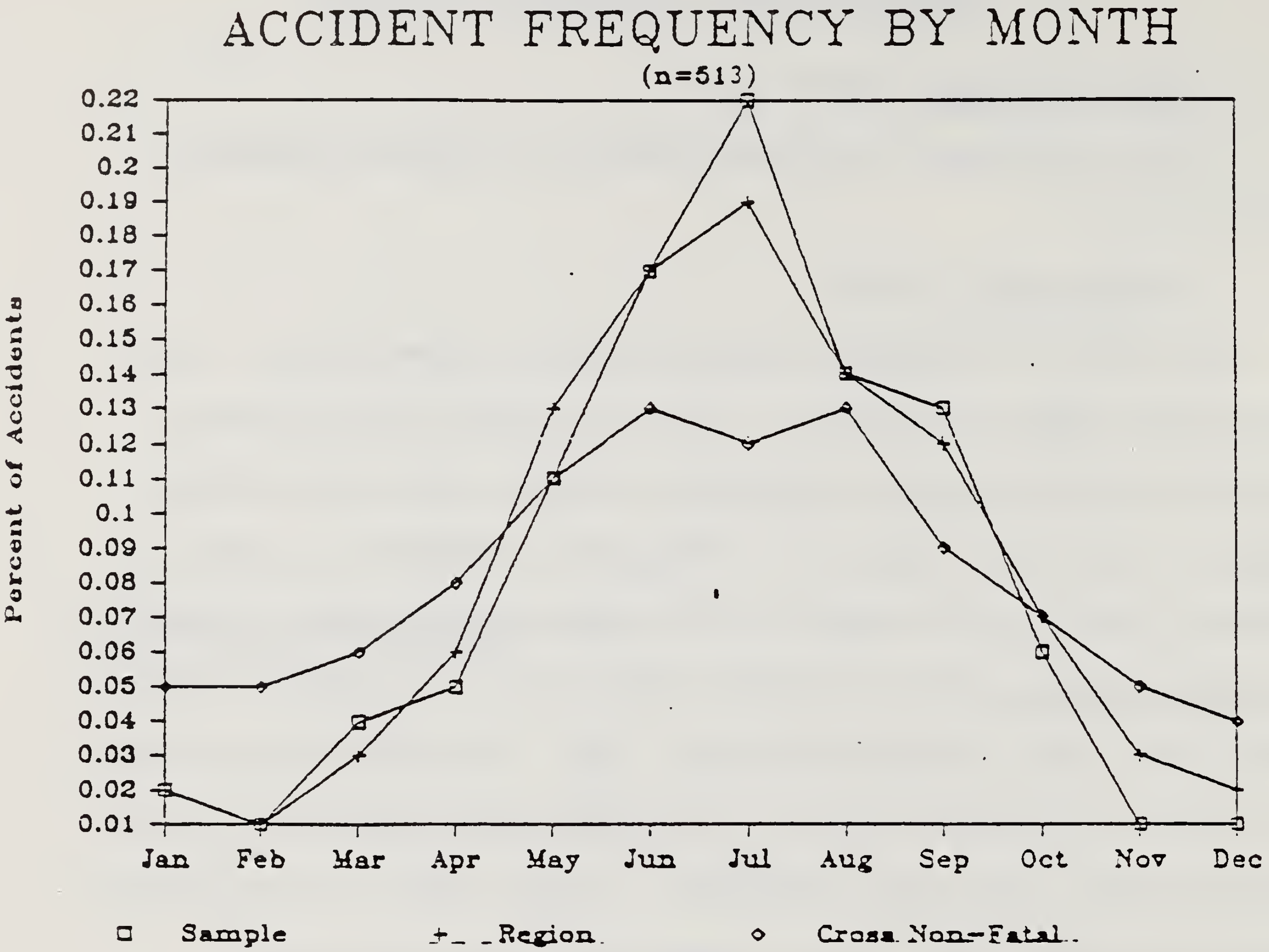
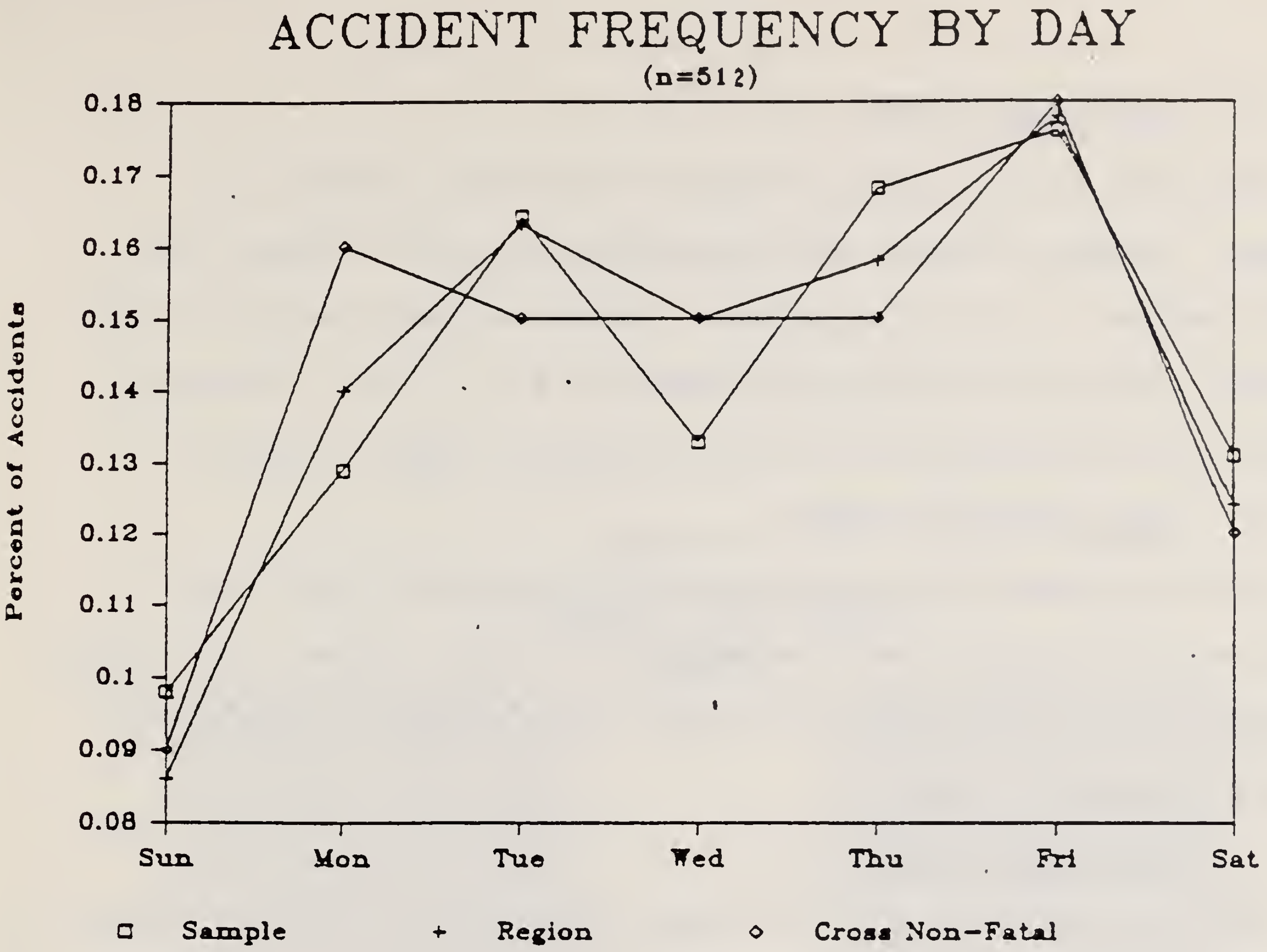

ACCIDENT FREQUENCY BY MONTH
(n=513)
Percent of Accidents
0.22
0.21
0.2
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
□ Sample
+ Region
◇ Cross Non-Fatal

Figure 3


ACCIDENT FREQUENCY BY DAY
(n=512)
Percent of Accidents
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
Sun
Mon
Tue
Wed
Thu
Fri
Sat
□ Sample
+ Region
◇ Cross Non-Fatal

D. Time of Day (n=479)

Accidents occurred during different time periods on weekdays and weekends. Weekday accidents were concentrated during the afternoon peak hours, between 3 - 7 p.m. (42 percent). Weekend accidents were more likely to occur during the mid-day period, between 10 a.m. - 3 p.m. (46 percent). These and the percentages for the other periods are shown in Figure 4.

E. Light Conditions (N=488)

Over 82 percent of accidents occurred during daylight (see Figure 5). The Cross study found a similar percentage of daylight accidents (85 percent), and noted this was consistent with several other studies of bicycle-motor vehicle accidents (p. 116).

F. Weather Conditions (N=481)

Most accidents occurred on clear days (88 percent). Cloudy (5 percent) and rainy (5 percent) weather were the next most likely conditions under which accidents occurred. Snow was reported in less than 2 percent of the cases. These findings are consistent with the Cross study (p. 118).

G. Road Surface (n=472)

Not suprisingly, given the above weather conditions, most of the accidents occurred on dry surfaces (91 percent). Wet surfaces accounted for 8 percent of the accidents, and snowy surfaces for less than 1 percent. Cross does not report on this variable separate from weather.

H. Road Condition (n=454)

Almost all of the accidents - 97 percent - occurred on roads with no defects. Another 3 percent occurred on roads with holes, ruts, foreign matter, or other non-ideal conditions. Over twelve percent of the accidents did not report on this item. These findings are different from those in the

Figure 4

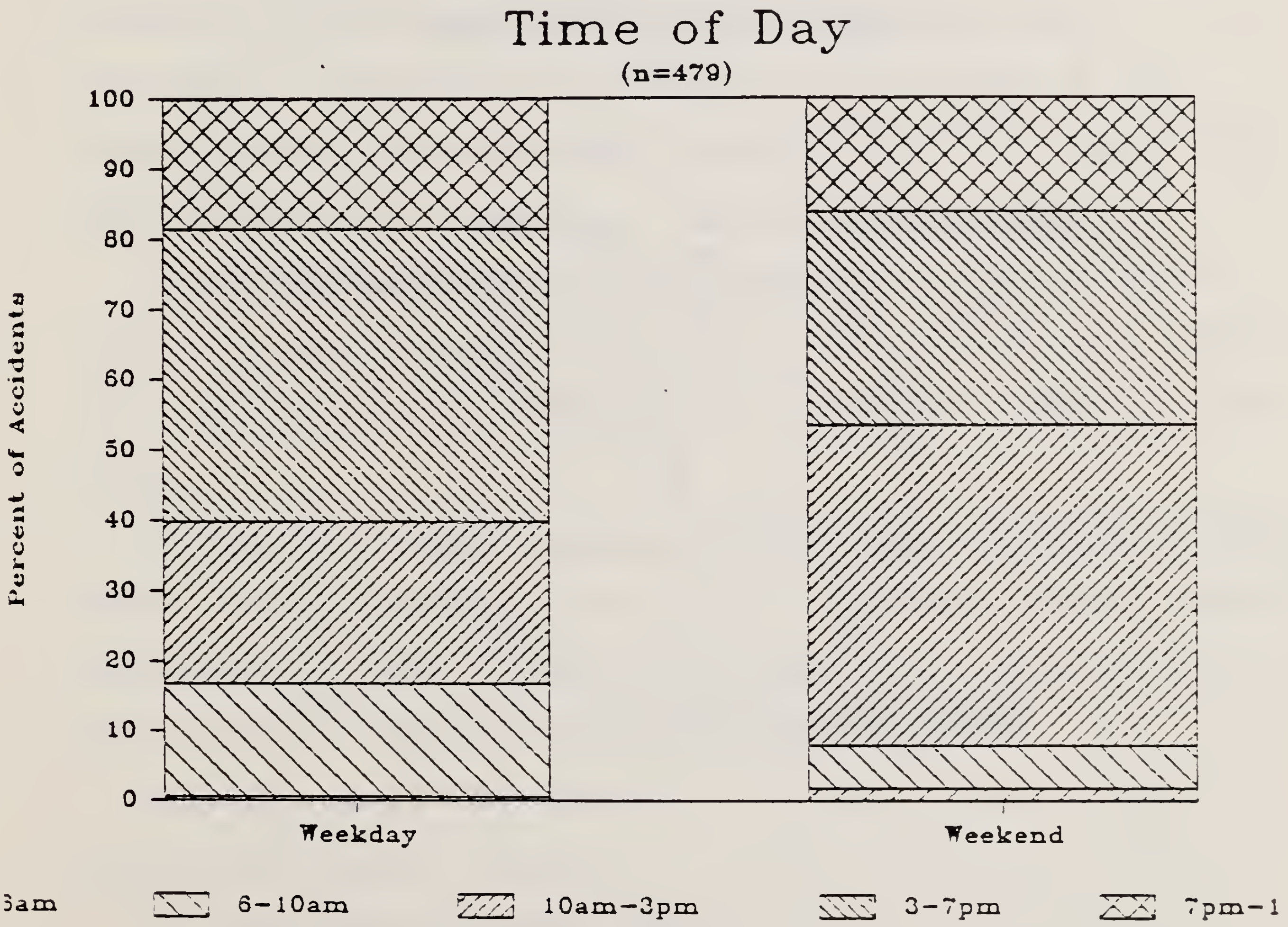
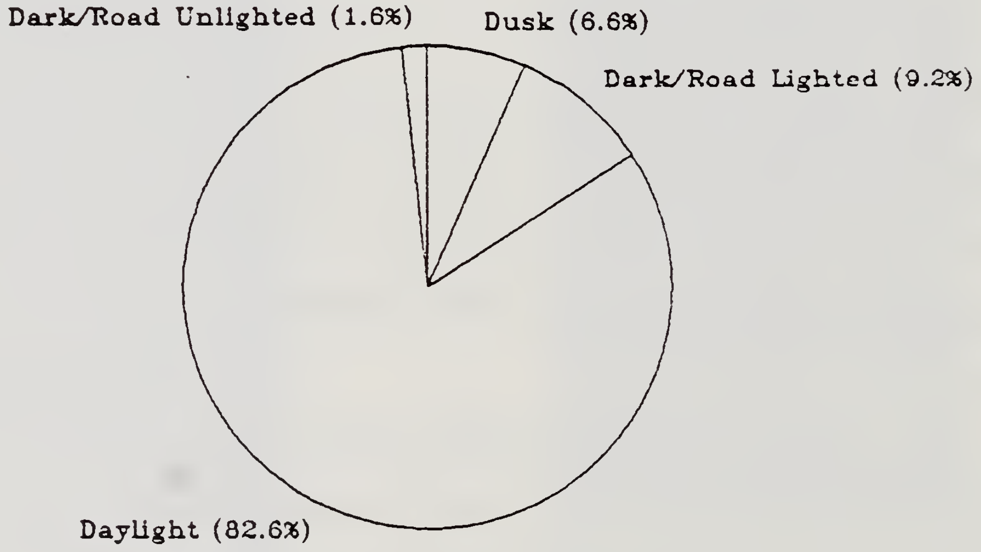

Time of Day
(n=479)
100
90
80
70
60
50
40
30
20
10
0
Percent of Accidents
Weekday
Weekend
3am
6-10am
10am-3pm
3-7pm
7pm-1

Figure 5

Light Conditions

(n=488)



Cross study (p.135). They also reflect the judgement primarily of operators and police, who filed most of the reports studied. As so few bicyclists completed reports, it is not possible to determine whether their greater sensitivity to the condition of the road would result in a more critical judgment.

I. Age of Cyclist (n=382)

Table 1 shows the distribution of the ages of bicyclists involved in accidents, using the same categories chosen for the Cross study. Unfortunately, the cyclist's age was not given on 26 percent of the accident reports. Percentages both including and excluding these unlisted ages are shown.

As can be seen from Table 1, cyclists between the ages of 6 and 19 accounted for over 65 percent of the accidents in the MAPC study. Although this is high, it is still less than that accounted for in the Cross study (p. 83).

Age was not recorded in Bicycle Traffic Volumes in Metropolitan Boston. However, the large number of universities in the area may suggest a somewhat higher number of riders in the 17-25 age group (many of these colleges have graduate schools) than other areas with fewer universities.

Over 30 percent of the accidents on which age was given occurred to cyclists over the age of 20 years.

J. Cyclist Wearing Helmet (n=516)

In over 97 percent of the cases, the reporter did not check off that the bicyclist was wearing a helmet. In 3 percent of the cases, it was checked. However, the form of the question - a box with the instruction "Check if wearing helmet" - and its obscure placement raise the possibility that many persons did not see the question.

Table 1

Age of Bicyclist

Age	# of Accidents (n=516)	% (including "Not Listed") (n=516)	% excluding "Not Listed") (n=382)	Cross Study (Non-Fatal) (n=753)
<6	10	2	3	2
6-11	81	16	21	28
12-15	89	17	23	37
16-19	80	16	21	14
20-29	66	13	17	12
30-44	37	7	10	4
45-59	15	3	4	2
60	4	1	1	2
NA	134	26	-	-
	516	100*	100	100*

*Actual total exceeds 100% due to rounding.

K. Cyclist Injury (n=516)

In almost three-quarters of the accidents, the cyclist was reported as being injured or killed (73 percent). One fatality was obtained from our sampling procedure. However, eight fatalities occurred in the study area during the study period, and all were included in our sample, resulting in an overrepresentation of fatalities.

L. Seriousness of Cyclist Injury (n=382)

The accident report form's injury categories and the proportions in each category are shown below. Only accidents involving an injury or fatality are included in calculating percentages.

• Killed (see K, above)	2%
• Visible signs of injury, as bleeding wound, or distorted member; or had to be carried from scene	31%
• Other visible injury, as bruises, abrasions, swelling, limping, etc.	45%
• No visible injury but complaints of pain or momentary unconsciousness	22%

M. Other Persons Injured

In only 12 cases - 2 percent - was a person other than the cyclist injured. In 10 of these cases, it was another cyclist. In one case, it was a cyclist passenger, and, in another, a driver passenger. In three other cases, the identity of the person injured was not shown. These results were similar to the findings in the Cross study.

N. Severity of Other Person's Injuries (n=12)

The severity of other person's injuries was reported as follows:

• Killed	0%
• Visible signs of injury, as bleeding wound, or distorted member; or had to be carried from scene.	33%
• Other visible injury, as bruises, abrasions, swelling, limping, etc.	42%
• No visible injury, but complaints of pain or momentary unconsciousness	25%

O. Accident's Roadway Location (n=491)

The majority of the accidents occurred at intersections (52 percent). After intersections, mid-block locations accounted for the largest portion (30 percent), followed by driveways (16 percent). Alleys, rotaries, off-ramps, parking lots and other locations accounted for only a negligible proportion of accidents (2 percents).

The Cross study (p. 128) reported a lower proportion of accidents at intersections (44 percent) and a slightly higher proportion of mid-block locations (34 percent). This is probably due to the greater number of rural roads included in the study.

P. Traffic Controls Present (n=241) (12).

For the most part, traffic controls were only indicated on reports where accidents occurred at intersections. These were distributed as shown on on Table 2.

Table 2

Traffic Controls Present
(n=241)

Type of Control	Percentage	Cross Percentage
Stop Sign	27%	59%
Signal Light	35%	30%
No Controls	36%	11%
Other	2%	-
	100%	100%

Traffic control information was not available for six percent of the intersections.

The Cross study thus showed a much higher percentage of the intersections with stop signs, and a much lower percentage with no controls. The proportion with signal lights was approximately the same. It is likely that the differences are due in part to a higher proportion of uncontrolled intersections in the MAPC region. However, in the absence of additional information on this subject, the extent to which other factors account for the difference (e.g. failure of cyclists or motorists to yield at these intersections) is unknown.

Q. Situation For Motorist (Prior to Accident) (n=476)

Motorists proceeding straight accounted for the highest proportion of accidents (48 percent). Right turns (16 percent) and left turns (15 percent) were the next most likely maneuver prior to the accident. Parked cars (6 percent) accounted for a significant number of accidents. Figure 6 displays these results.

R. Situation For Cyclist (Prior to Accident) (n=206)

Cyclists proceeding straight accounted for 63 percent of the accidents

Figure 6

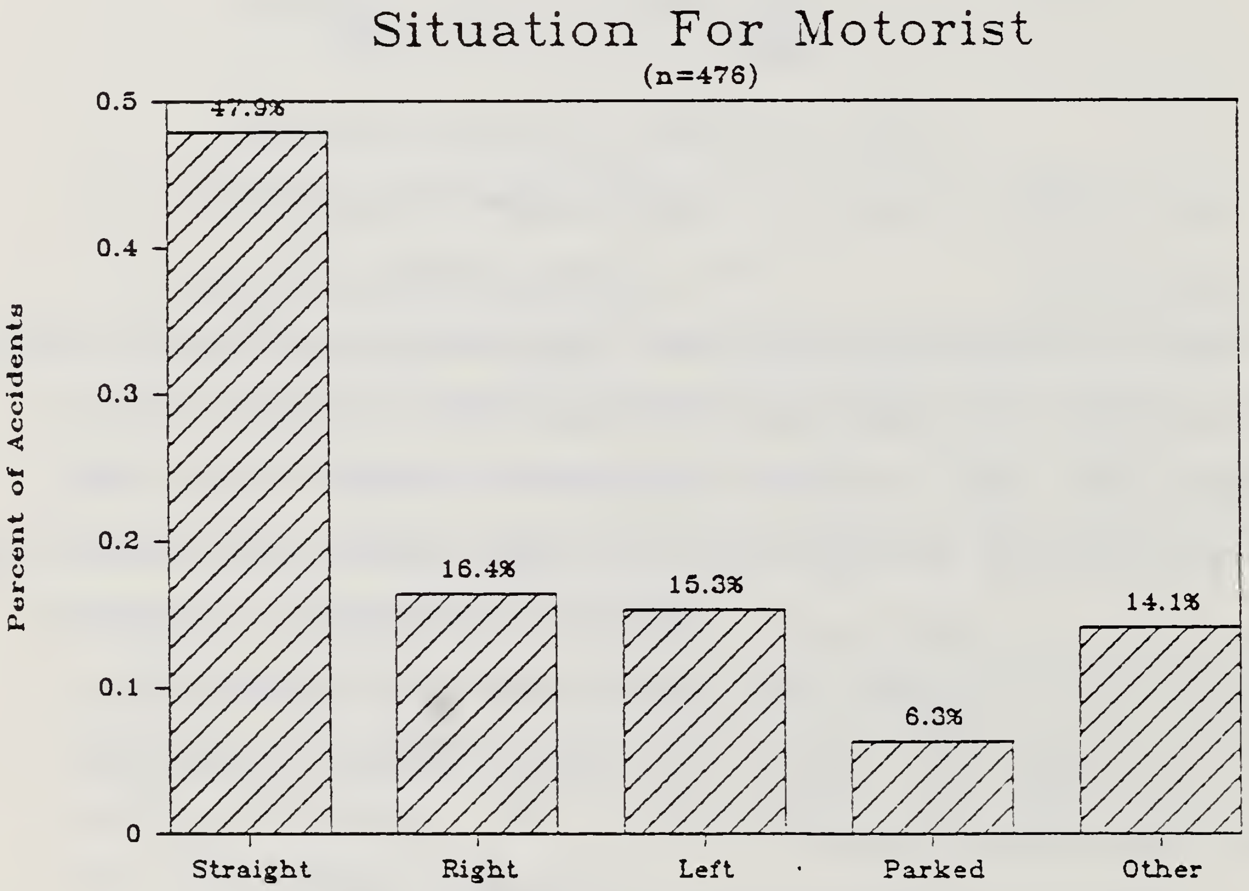
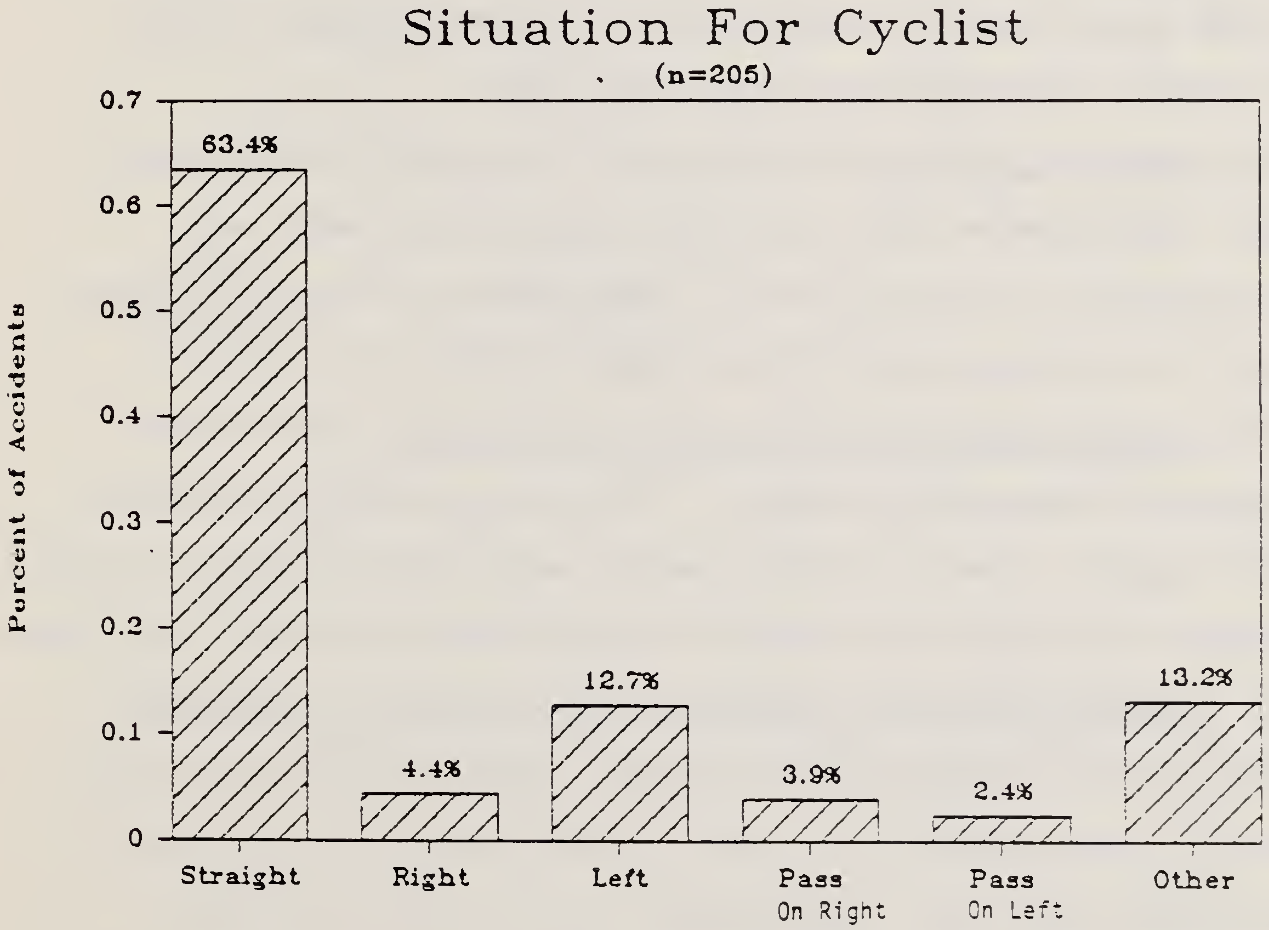

Situation For Motorist
(n=476)
Percent of Accidents
0.5
0.4
0.3
0.2
0.1
0
47.9%
16.4%
15.3%
6.3%
14.1%
Straight
Right
Left
Parked
Other

Figure 7


Situation For Cyclist
(n=205)
Percent of Accidents
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
63.4%
4.4%
12.7%
3.9%
2.4%
13.2%
Straight
Right
Left
Pass On Right
Pass On Left
Other

for which this information was available, followed by 13 percent making left turns. Right turns, passing and other movements accounted for the remainder (24 percent). Unfortunately, the situation for the cyclist was only reported on 40 percent of the accident reports, making it difficult to assess the accuracy of these statistics for the overall sample. Figure 7 displays these results.

S. Cyclist Violations

Three types of cyclist violations were reported: wrong-way riding, riding through a red light and running a stop sign.

1) Wrong -way cyclists were reported in 24 percent of the accidents (n=442). Cross reported that 19 percent of the non-fatal sample were traveling against the flow of traffic. These proportions must be considered in light of the fact that most cyclists observe directional rules.

2) Cyclists entering an intersection on a red light were involved in 6 percent of the accidents (N=465). The Cross study noted no accidents in this situation. However, Cross' standards were somewhat higher in assigning an accident to this type (i.e. that the cyclist entered after the light turned red).

3) Cyclists entering an intersection without observing a stop sign accounted for only 2 percent of the accidents (n=477). On the other hand, 8 percent of the accidents in the Cross non-fatal sample were considered to have violated a stop sign. The difference here may be due to the much higher percentage of signed intersections included in the Cross study, and the greater difficulty of our coder, in the absence of an interview, in determing whether the stop sign was obeyed.

T. Motorist Violations (Red Light: n=482; Stop Sign: n-470)

In fewer than 2 percent of the cases did the motorist run a red light or a stop sign. This is consistent with the Cross study (p. 160).

U. Accident Distribution by City or Town (n=514)

Figure 8 shows the distribution of accidents. Statistical tests show this distribution to be similar to that of all bicycle-motor vehicles accidents reported during the study years. (Pearson' Chi Square, 34 df, $p < .05$).

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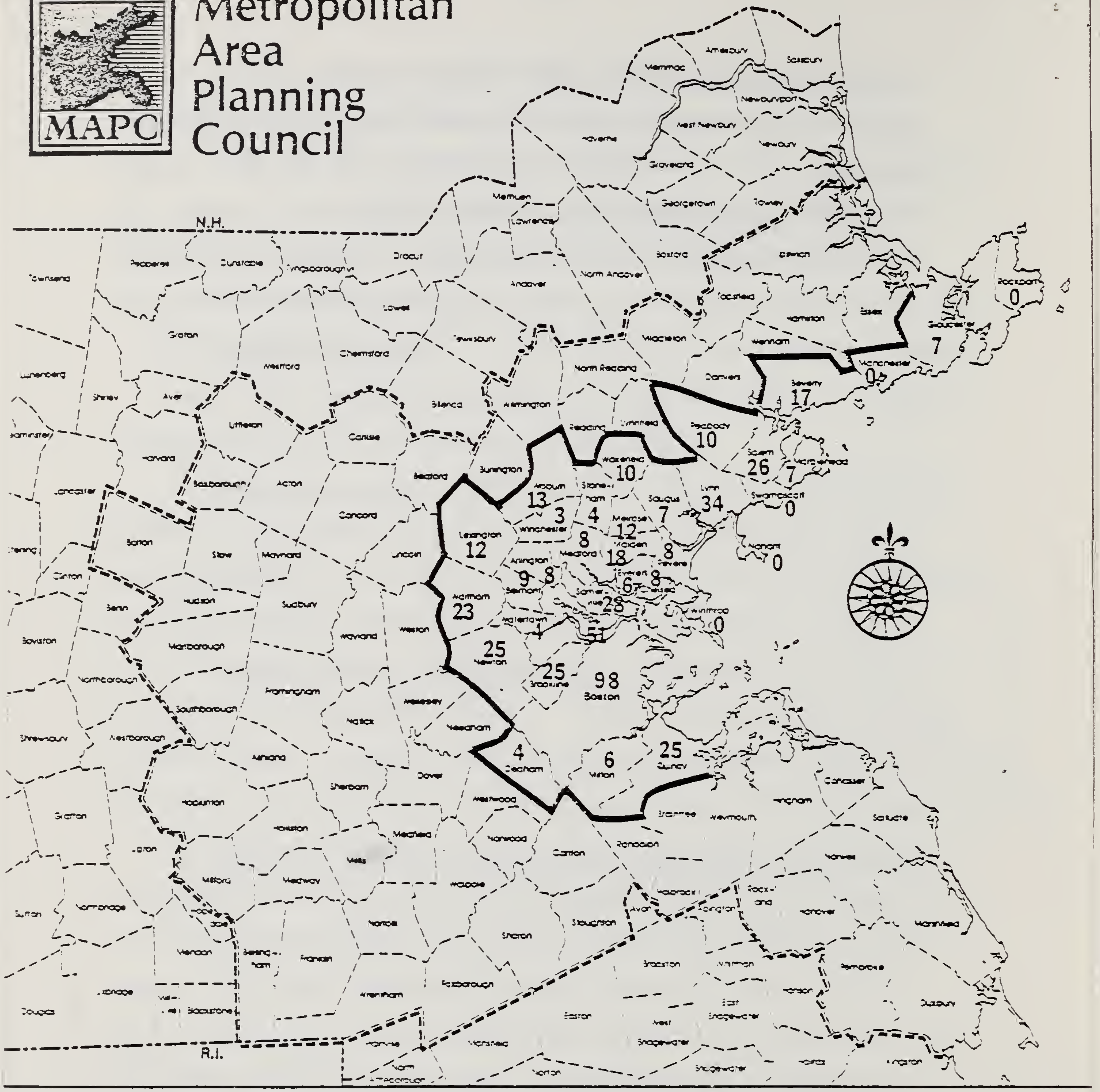


Bicycle Accident Study
1983

Distribution of Accidents by Community

Sample size is 516 Accidents

▬ Study Area Boundary

---- MAPC Boundary

Scale in Miles

FIGURE 3

III. RESULTS OF STUDY - ACCIDENT CLASSIFICATIONS

On Tables 3 and 4, the distribution of accidents by classes and types is shown. Table 3 shows the distribution using the original Cross classification scheme, allowing comparison of MAPC data with both the Cross and the Missoula, Montana studies. Table 3 shows the distribution using the modified Cross scheme, based on the Manual Accident Typing (MAT) system created by the National Highway Traffic Safety Administration, which added seven new types to the Cross scheme (see Introduction, sections on Methodology and the MAT).

In using this system, MAPC also removed one prominent accident type - involving opening doors of parked cars - from the original Cross Type 17 and included it with two other types in a new Class G, "Slowed or Parked Cars." "Other" types were grouped together in Class H. MAPC believes taht these revisions improve the classification system. This revised classification is used in the cross-tabulations with other variables in the study.

The classes are reviewed in the order of their frequency of occurrence in the MAPC study. Following the name of the class are four percentages: the MAPC revised MAT classification frequency; the MAPC original Cross system frequency; the Cross non-fatal sample frequency; and the Missoula, Montana frequency.

In addition to the frequency of occurrence, the relationship of each class to four other variables in the study is observed: wrong-way riding, age of cyclist, time of occurrence and the severity of injury. Finally, those accident types within the class with high frequencies are noted.

1) Class F: Motorist Unexpected Turn (MAPC Rev: 17.2%, MAPC: 17.6%; Cross NF: 14.5%; Missoula: 20.0%)

This class involved accidents where a motorist who is turning right or left at an intersection (excluding right turns-on-red) collides with a bicyclist approaching from the motorist's front or rear. Only 14 percent of these accidents involved a wrong-way cyclist, compared to the 24 percent of all

Table 3

A Comparison of the MAPC Class Data With the Missoula, Montana and National Cross/Fisher Studies

		MAPC Number	MAPC Percentage	Missoula Percentage	Cross/Fisher Study (injuries/fatalities)
Class A:	Bicycle ride-out from driveway, alley and other midblock locations	71	16.4%	8.9%*	13.9%/15.1%
Class B:	Bicycle ride-out at controlled intersection	41	9.5%	10.0%	17.0%/12.0%***
Class C:	Motorist turn/merge/drive through/drive-out	68	15.7%	23.3%*	18.7%/2.4%
Class D:	Motorist over-taking/over-taking threat	36	8.3%	13.3%	10.5%/37.8%***
Class E:	Bicyclist unexpected turns/swerve	38	8.8%	8.9%	14.2%/16.2%**
Class F:	Motorist unexpected turn	76	17.6%	20.0%	14.5%/2.4%**
Class G:	Other	102	23.6%	15.6%*	11.2%/13.8%***
		432	100.0%	100.0%	100.0%/100.0%
			(432)	(91)	(753/166)

Difference from MAPC Sample

*p<.10 **p<.05 ***p<.01

Table 4

Revised MAPC Accident Classifications

With Selected Crosstabulations

					Weekday(c)			
				(b)	%(b)	%(b)	%(b)	%(b)
			%(b)	% Over	A.M. Peak	Midday	P.M. Peak	Evening
		(a)	Wrong	18	6-10 a.m.	10 a.m.-	3-7 p.m.	7 p.m.-
	#	%	Way	Years		3 p.m.		1 a.m.
lass A: Bicycle Ride-Out at Driveway, Alley or Mid-block	71	16.6	9.9	6.4	8.3	25.0	56.2	10.4
lass B: Bicycle Ride-Out at Intersection	51	11.9	17.6	21.6	24.3	8.1	51.4	16.2
lass C: Motorist Driveout	72	16.8	47.2	41.2	7.1	35.7	37.5	19.6
lass D: Motorist Overtaking/ Overtaking Threat	15	3.5	6.7	41.7	9.1	27.3	36.4	27.3
lass E: Bicyclist Unexpected Turn/Swerve	38	8.8	21.0	7.7	7.1	25.0	39.3	28.6
lass F: Motorist Turn	74	17.2	13.5	55.2	17.3	23.1	40.4	19.2
lass G Revised: Slowed or Parked Car	49	11.4	10.2	64.5	29.4	26.5	29.4	14.7
lass H: Revised: Other	59	13.8	42.4	28.6	17.1	22.0	39.2	26.8
otal (Percentages)	-		24.0	31.2	15.0	24.4	41.4	19.2
otal (Number)	429	-	99	100	46	75	127	59
			n=412	n=320		n=307		

Percent of sample (b) Percent of class (c) No weekday accidents were reported between 1 a.m. - 6 a.m.

Table 4 (cont.)

Revised MAPC Accident Classifications With Selected Crosstabulations	#	(a) %	% Death	Severity of Injuries (b) n=429 % Bleeding Wounds, Distorted Member, etc.	% Bruises, Abrasions, etc.	% Pain or Momentary Un- consciousness	% None Reported
lass A: Bicycle Ride-Out at Driveway, Alley or Mid-block	71	16.6	1.4	25.4	30.0	15.5	28.2
lass B: Bicycle Ride-Out at Intersection	51	11.9	3.9	25.5	39.2	9.8	21.6
lass C. Motorist Driveout	72	16.8	1.4	13.9	37.5	12.5	34.7
lass D: Motorist Overtaking/ Overtaking Threat	15	3.5	6.7	20.0	26.7	40.0	6.7
lass E: Bicyclist Unexpected Turn/Swerve	38	8.8	0.0	23.7	36.8	23.7	15.8
lass F: Motorist Turn	74	17.2	1.4	20.3	37.8	17.6	23.0
lass G (Revised): Slowed or Parked Car	49	11.4	2.0	22.4	16.3	32.6	26.5
lass H (Revised): Other	59	13.8	1.7	35.6	18.6	15.2	28.8
otal (Percentages)	-	100.0	1.9	23.3	32.9	16.3	25.6
otal (Number)	429	-	8	100	141	70	110

a) Percent of sample

b) Percent of class

accidents involving wrong-way cyclists (however, 5 of the 6 accidents included in Type 22, "Motorist Left Turn; Parallel Paths; Same Direction" involved wrong-way cyclists).

Cyclists 15 years of age and over accounted for over 87 percent of these accidents. Those over 18 years of age accounted for over 55 percent of the cases. As with the other classes of accidents, approximately three-quarters of Class F accidents occurred on weekdays. Most often, these occurred during the afternoon peak, between 3-7 p.m. (40 percent). On weekends, these accidents were more likely to occur between 10 a.m. - 3 p.m. (50 percent).

Class F accidents showed a similar distribution in the incidence and type of injury as the sample as a whole.

The most frequent type of accident within this class is the motorist turning left in front of a cyclist coming from the opposite direction (Type 23). This was the most frequent accident type in the study. The next most frequent type within Class F is the motorist turning right in front of a cyclist coming from the same or opposite direciton (Type 24 - 6 percent). Least frequent in this class was the accident type involving a motorist turning left in front of a cyclist coming from the same direction (Type 22 - 1 percent). As pointed out above, however, wrong-way riders accounted for 83 percent of Type 22 accidents.

2) Class C: Motorist Driveout (MAPC Rev: 16.8%; MAPC: 15.7%;
Cross NF: 18.7%; Missoula: 23.3%)

This class involves a motorist emerging from an intersection, driveway or alley onto a roadway, and colliding with a bicyclist on that roadway. Right turns-on-red are included as Type 10. While Cross limited intersection accidents in this class to those where the motorist's approach was controlled by a sign or signal, the MAT added Type 48 to this class. Type 48 accidents involve a collision at an uncontrolled intersection where it is established that the motorist failed to yield to the cyclist.

Wrong-way cyclists were over-represented in this class, relative to the sample as a whole involved in 49 percent of Class C accidents, compared to 24 percent of all accidents.

Class C accidents occurred among a slightly older population than the other classes. Over 76 percent occurred among cyclists over 15 years of age, and 31 percent involved cyclists over 25 years of age.

Class C accidents occurred on weekdays in the same proportion as all accidents. Mid-day weekday accidents are over-represented in this class -- 36 percent occurred during the hours of 10 a.m. to 3 p.m. compared to 24 percent of all accidents. The afternoon peak period was the next most likely time period to experience these accidents (38 percent, compared to 41 percent of all accidents).

Weekend Class C accidents were most likely to occur during the 10 a.m- 3 p.m. period (58 percent for Class C versus 47 percent of all weekend accidents).

Class C accidents were somewhat less likely than other classes to result in fatalities or the most serious injuries, and somewhat more likely to result in no injury at all.

The most common type of accident within Class C was Type 9 - "Motorist failure to yield at stop or yield sign" - 9 percent of all accidents. This was the second most common type of accident in the study. Wrong-way cyclists were involved in 53 percent of Type 9 accidents.

3) Class A: Bicycle Rideout From Driveway, Alley and Other Mid-block Locations (MAPC Rev: 16.6%; MAPC: 16.4%; Cross NF: 13.9% Missoula: 8.9%)

This class includes a cyclist emerging from a residential or commercial driveway, alley or sidewalk and colliding with a motor vehicle approaching on the roadway. Only 10 percent of these accidents involved a wrong-way cyclist (compared to the 24 percent of wrong-way cyclists in the sample).

Over 90 percent of Class A accidents involved cyclists 14 years of age and under. This class was by far the most likely to occur to younger cyclists.

Class A accidents most frequently occurred on weekdays (75 percent). Fifty-six percent of Class A weekday accidents took place between 3 p.m. and 7 p.m., the highest proportion of any class to occur within the afternoon peak. On the weekends, these accidents were more likely to occur between 10 a.m. and 3 p.m. (44 percent, similar to the 47 percent share of all weekend accidents occurring during this period).

Class A accidents were among the most likely to result in the most serious category of non-fatal injury ("visible signs of injury, such as bleeding wounds or distorted member; or had to be carried from scene).

4) Class H (Revised): Other Accidents (MAPC Rev: 13.8%; MAPC Class G: 23.6%
Cross NF: 11.2%; Missoula: 15.6%)

Class H involves accident types which do not fit into the other classes. It thus differs from Classes A through G by the lack of commonality among the types included in this class.

As noted in the introduction to this section, Class H has been revised from the original Class G by removing two types which have been placed in the new Class G, "Slowed or Parked Cars" (Type 27, "Bicyclist Overtaking" and Type 35, "Motorist Drive-out From On-Street Parking").

Within this class, the most frequent types of accidents are:

Type 25: Accident occurs at uncontrolled intersection

Type 26: Vehicles collide head on, wrong-way cyclist

Type 25 accidents include those which occur at uncontrolled intersections, and where failure to yield is not apparent from the accident report. In the Cross study, all accidents occuring at uncontrolled intersecitons were included in this type (even where "fault" was assignable), and the MAPC share (7 percent) of accidents of this type using this definition was much greater than in the Cross or Missoula studies. Undoubtedly, this resulted from the larger proportion of accidents at uncontrolled intersections in the MAPC study (36 percent of all intersection accidents versus 10 percent in the Cross study).

5) Class B: Bicycle Ride-Out At Intersection (MAPC Rev: 11.9%; MAPC: 9.4%; Cross NF: 17.%; Missoula: 10%)

Class B accidents involve bicyclists emerging from one leg of an intersection, and colliding with a motorist emerging from the orthogonal leg of the intersection. Wrong-way cyclists were involved in 18 percent of Class B accidents, compared to their 24 percent share of all accidents.

Unlike Class A accidents, which involved bicycle ride-out from mid-block locations, Class B accidents occur among a slightly older population. Over 21 percent of these accidents occurred among bicyclists over 25 years of age (approximately the same proportion in which this age group is represented in the study sample). None of these accidents occurred to cyclists between 19 and 25 years of age; whereas over 40 percent occurred among those between 15 and 18 years. In fact, the 19-25 year age group seemed remarkably exempt from accidents. Twenty-one percent of Class B accidents occurred among cyclists between the ages of 12 and 14, and sixteen percent among those under 11 years of age.

Class B weekday accidents occurred with a greater frequency during both the morning peak hours (24 versus 15 percent) and afternoon peak hours (51 versus 41 percent) than did other accident classes. This was also true on weekends (20 percent, morning peak; 50 percent, afternoon peak). They were less likely than other accident classesto occur during mid-day, particularly on weekdays (8 percent versus 29 percent).

Class B accidents were slightly over-represented among the accidents involving serious injuries.

The most frequent type among Class B accidents was an unnumbered type "-", "Bicyclists entering intersections on a red light." The 6.5 percent of accidents occurring in this type was higher than both the Cross and Missoula studies, which showed 1.2 percent and 0 percent, respectively, of this type of accident. This discrepancy may in part be due to coding; Cross indicates in his narrative that he was only likely to include an accident in this type if the cyclist emerged well after the light turned red. The MAPC coder generally placed an accident in this type whenever the cyclist entered on the red.

6) Class G: Slowed or Parked Cars (MAPC Rev: 11.3%; MAPC: NA; Cross NF: 2.07%; Missoula: 3.3%)

This class, which was created for the MAPC study, includes accidents in which a bicycle collides with a motor vehicle that is slowed or stopped in traffic, entering or exiting on-street parking, or that has a door opening to let the driver out. Comparison with the percentages for the Cross and Missoula studies of the aggregates of these three types of accidents show that the MAPC region is much higher in the relative frequency with which these accidents occur. This may be due to the greater congestion and narrower widths of the major urban thoroughfares in the MAPC study area.

Only 10 percent of Class G accidents involved wrong-way cyclists, compared to 24 percent of all accidents in the study.

Class G accidents are more common among older bicyclists, with 87 percent occurring among bicyclists 15 years of age and over. Over 64 percent of these accidents occur among bicyclists over 18 years of age.

Class G accidents are unusual in that, unlike all other classes except for Class B, they occur with a greater relative frequency during the morning peak hours (between 6 a.m. and 10 a.m.), both on weekdays and weekends.

Class G acidents are somewhat less likely to occur during the afternoon peak hours (29 percent versus 41 percent of all accidents occurring during the afternoon peak).

In spite of the fact that these accidents involve a slowed or stopped motor vehicle, they are as likely to result in serious injury as the other accidents studied.

The most frequent type represented in this class is Type 41, "Cyclist strikes open door on driver's side of parked car," containing 5.3 percent of all accidents. This type accounted for only .8 percent of all accidents in the Cross study, and they were negligible enough in the Missoula study to be classified as Type 36, "Weird." Again, further investigation is needed to explain this higher relative frequency, but it is reasonable to guess that the Boston area's narrow streets and traffic congestion are significant factors in causing this accident.

7) Class E: Bicyclist Unexpected Turn/Swerve (MAPC Rev: 8.9%; MAPC 8.8%;
Cross NF: 14.2%; Missoula 8.9%

Class E accidents involve a bicyclist turning into the path of a motorist approaching from behind or ahead.

Wrong-way cyclists were involved in 21 percent of these accidents, close to the 24 percent of all accidents involving wrong-way cyclists.

Like Class A accidents, Class E accidents occurred among a younger population - 42 percent among bicyclists age 11 and under. Cylists between 15 and 18 years of age were also overrepresented in this age group, with 35 percent of Class E accidents.

Class E accidents occurred more frequently during the weekday evening hours (7 pm-1 am) than did the sample as a whole (29 percent versus 19 percent). They were most likely to occur during the afternoon peak (39 percent). On weekends, they were twice as likely as the average acident to occur during the afternoon peak, (14 percent compared to 7 percent).

Class E accidents distributed themselves among the various injury levels in approximately the same proportion as the overall sample.

Type 18 accidents - "Bicyclist unexpected left turn with auto approaching from same direction" - accounted for the greatest proportion of Class E accidents.

8) Class D: Motorist Overtaking/Overtaking Threat (MAPC Rev: 3.4%; MAPC 8.3%; Cross NF: 10.5%; Missoula: 13.3%

Class D accidents involved a motorist striking a bicycle from behind or aside of the bicyclist. As with the Cross study, this was the least frequent class in the study. The difference between the revised MAPC percentage and the MAPC Cross classification scheme percentage is the removal of parked car door accidents from this class and their placement in Class G.

Wrong-way riding contributed to only 7 percent of these accidents.

Class D accidents were most likely to occur among cyclists 15 years of age and over (67 percent).

Class D accidents were over-represented among evening and mid-day accidents (both 27 percent, compared to 19 percent and 24 percent for the sample). They occurred with greatest frequency during the afternoon peak (36 percent). All of the weekend Class D accidents occurred between 7 p.m. and 6 a.m.

Class D accidents were the least likely among all accident classes to result in no reported injuries, but, unlike the Cross study, they were more likely to cause minor injuries rather than the severe or fatal injuries. Given the smaller number of cases in this class, the one fatality that occurred comprised a higher proportion of Class D accidents (6.7 percent) than they did of any other accident class.

IV. RECOMMENDATIONS

The following recommendations are general in nature and are based upon an initial review of the data. Their purpose is to help reduce the number of accidents and to prevent the most frequent occurrences.

A. Publicity - These findings should be made available to the Registry of Motor Vehicles, local traffic safety officers, bicycle advocacy groups and local schools for inclusion into their own programs. The results of the study should also be developed into a series of public service announcements to be aired on the radio and television. These announcements will emphasize the highest frequency accident classes (e.g. motor vehicles turning into a bicyclist's path, motor vehicles colliding with a bicyclist at an intersection) and types (e.g. parked car door openings). The purpose of the publicity is to encourage further analysis of the findings and identification of countermeasures, and to increase awareness at the most frequent accidents.

B. Additional exposure information - The foregoing discussion lacks an essential element - the measurement of risk as well as frequency. Other than Cathy Buckley's Bicycle Traffic Volumes in Metropolitan Boston, little information exists on bicycle ridership and ridership habits in the greater Boston area. Additional information should be obtained to allow an assessment of the likelihood of a specific accident type occurring to an individual, as well as the overall frequency.

C. Education - The study's findings indicate high frequency accidents that can be reduced or prevented in part by education. Education has the dual goal of increasing awareness of an undesirable situation and providing the necessary skills to avoid the situation. The presence of a high proportion of accidents involving intersection collisions indicates the opportunity additional traning may offer in this area, particularly among adults, among whom these accidents occurred most often. Although this type of accident may be no riskier - or even less risky - than other accidents, the volume of bicyclists entering intersections on busy downtown streets could itself be responsible for the high ranking. Eliminating or reducing this type of accident would affect a large portion of accidents in the study area.

Bicyclists in the Boston area agree with Kenneth Cross' assessment that wrong-way riding occurs among bicyclists in a lower proportion than it shows up in accidents. Awareness of the role of wrong-way riding in contributing to accidents may also result in a decrease in that riding behavior and a reduction in accidents.

The Registry of Motor Vehicles can also provide motorists with information on improving their search skills in spotting bicyclists at intersections, and emphasize this in its driver's education materials.

D. Enforcement - Education and awareness are likely to improve the skills and behavior of only some bicyclists and motorists, while others may not be exposed to the education/publicity or may choose to ignore it. Law enforcement officials must impress on bicyclists in particular that wrong-way riding is illegal as well as dangerous. Currently, bicyclists are rarely cited or stopped for wrong-way riding in the Boston area.

E. Improved record keeping - Local police departments for the most part have no separate file of bicycle-motor vehicle accidents, and are thus not able to carry on an elementary classification of bicycle accidents in their own communities. Police departments should create such files and review them periodically. Similarly, the Registry of Motor Vehicles should establish a separate file of bicycle-motor vehicle accidents to allow easy reference and analysis, and develop a campaign to obtain the cooperation of local police departments in doing the same.

F. Improved reporting - The quality of data on cyclists was markedly poorer than that on motor vehicle operators. Age of the cyclist was not reported on 26 percent of the sample reports (compared to less than 1 percent of the motor vehicle operators); situation for cyclist was not reported on 60 percent of the sample reports (compared to 8 percent for the situation on the motorists). In many cases, information on the bicyclist was only reported under the "Injured" section (see Appendix A) rather than in the "Vehicle" section, indicating that police and operators do not consistently identify the bicycle as a vehicle. In addition, information on traffic controls at the bicyclist's approach of an intersection was inaccurate on many reports (both police and operator). Anecdotal evidence also has suggested that "road surface" and "road condition" may not be reported accurately on many reports. Finally, the question on helmet use was phrased in such a way as to not allow a distinction between "No use" and no response.

In the narrative and diagram sections of the report, little information was provided on whether the bicyclist observed a stop sign. As this has been identified in the Cross report as a key variable in accident causation, it would be useful to increase reporting of this information in these sections.

Reporting could be improved in three ways. The Registry should actively encourage police and operators to solicit from and record complete information on both the motor vehicle operator and bicyclist, and to treat the bicycle as a vehicle. The Registry, MAPC and the Boston Area Bicycle Coalition should encourage bicyclists to complete reports on all motor vehicle collisions in which they are involved (less than 1 percent of the sample reports were filed by bicyclists). Finally, the Registry should consider revising the accident report form to address the problems identified above (e.g. rephrasing the helmet question; adding the phrase "including bicycles, motorcycles, mopeds" after the word "vehicle".) We would be happy to meet with the Registry to discuss and expand upon these recommendations.

Acknowledgements

This study has been accomplished with the cooperation of many individuals in many agencies. It was funded through the Environmental Protection Agency's Section 175 Air Quality program, which is administered by the Urban Mass Transportation Administration. The Massachusetts Registry of Motor Vehicles made the study possible by making available its microfilm of accident reports. Robert Carroll, William Wood and Paul Guerino were especially helpful in explaining the system and providing material.

The Massachusetts Department of Public Works provided print-outs of all accidents from which the sample was selected. John Hickey consistently displayed patience and cooperation in supplying us with listings that met the special needs of the study.

The volunteers who collected data in the six communities provided this insight into the bicycle accident report-keeping systems of local police departments. They devoted many hours, sometimes on evenings or the weekends, reviewing and recording the data. Charles Hyde-Wright, Betsy Edge, Enid Paul, David Brahmer, Louise Segal, Karen McLaughlin, J. Lynn Wolk and David Cain all made a contribution to the bicycling community in providing this service.

Sarah Heartt, John Allen, Charles Hyde-Wright and Webb Sussman of the Boston Area Bicycle Coalition (BABC), David Brahmer of the Charles River Wheelmen, Richard Norcross of the American Youth Hostels, and Cathy Buckley of the Central Transportation Planning Staff provided valuable input into the study, including recruiting volunteers, reviewing the methodology and findings, and suggesting countermeasures. We will ask their assistance in publicizing the results as well. BABC is also planning to plot the locations of all accidents occurring within the MAPC region during the study years to identify high-frequency locations.

Of special mention is Dan Geer of the BABC, who provided many hours of volunteer assistance to carry out most of the computer analysis in the study.

Yong Chang and Dan Beagan of the Central Transportation Planning Staff (CTPS) provided ongoing technical support in selecting an appropriate sample size and advising on statistical tests. John Bliss and Dave Sarota were most helpful in transferring the data to the CTPS system.

Early in the study, Richard Dueker of Applied Science Associates, Inc., which prepared the Manual Typing System, provided phone advice on a sampling procedure.

We are appreciative to the National Highway Traffic Safety Administration, to Kenneth Cross and to the City of Missoula, Montana for their pioneer work which we drew upon in performing our own study.

References

1. The Metropolitan Area Planning Council (MAPC) is the regional planning agency for the Boston metropolitan area, with 101 member communities. The other project, which is ongoing, is an employer-based incentive program for bicycle commuting.

2. Cross, K. *A Study of Bicycle/Motor-Vehicle Accidents: Identification of Problem Types and Countermeasure Approaches*. Washington, D.C.: U.S. Department of Transportation, September, 1977. Contract No. DOT-HS-00982 (Available from NTIS); Williams, J. "'Crossing' Your Accident Statistics" in *Bicycle Forum*, Volume 8 (Winter, 1981-1982), pp. 22-23.

3. Environmental Protection Agency, *Bicycling and Air Quality Information Document* (Office of Transportation and Land Use Policy, September, 1979), p. 18.

4. Cross, p. 1.

5. The similarity of the sample to all reported accidents in the study area was examined on the variables of month and city/town of accident. A high correlation was found (Pearson's Chi-Square, $p < .05$, 34 df, City/Town; $p < .02$, 34 df, Month).

6. This sample size allows generalization of the distribution of accident classes to the study area as a whole at a confidence level of approximately 90 percent. Any other breakdown of the data, such as into accident types or age groups, will differ in the extent to which they can be generalized.

7. U.S. Department of Transportation, National Highway Traffic Safety Administration, *Computer and Manual Accident Typing For Bicyclist Accidents: Administrator's Guide* (DOT-HS-806344), January, 1983, p. 6.

References (cont.)

8. Readers are encouraged to contact Wendy Plotkin at MAPC (617-451-2770) to request a detailed written description of the methodology. This will include a discussion of the problems involved in obtaining a record of bicycle-motor vehicle accidents, selecting a sample, retrieving the data (both from centralized state and local police files), using the data and classifying the accidents. This may be useful for other groups considering undertaking a similar study. The Manual Accident Typing Administrator's Guide contains a good discussion of potential problems as well (see Note 7).

9. In calculating the percentages for the frequencies, only the cases in which information was available on the variable being studied were included.

10. Significance tests for all comparisons in Sections II and III are being computed and will be available in February, 1984.

11. Buckley, C.A. Bicycle Traffic Volumes in Metropolitan Boston (Central Transportation Planning Staff, Boston, MA. December, 1982), pp. 11-12.

12. Traffic control information on the operators' reports proved to be unreliable when checked against the reviewer's knowledge of the intersection. This was generally true where the operator reported "No Controls." For this reason, all intersections where this choice was checked off on operators' reports were verified with the local police department. The figures above are based on the verified information.

APPENDIX A

SEND ONE COPY TO:
REGISTRAR OF MOTOR VEHICLES
100 NASHUA STREET
BOSTON, MASS. 02114

ONE COPY TO:
POLICE DEPARTMENT in whose jurisdiction the accident occurred.

MUST TYPE OR PRINT

COMMONWEALTH OF MASSACHUSETTS
OPERATOR'S REPORT OF MOTOR VEHICLE ACCIDENT

SAMPLE

REGISTRY USE ONLY

2-7

8-10

19 Was this Accident investigated by an Officer? If Yes, Check One Box Below
1 ☐ Registry 2 ☐ MDC 3 ☐ Other 4 ☐ State Police 5 ☐ Local Police

11-15 Date of Accident Mo. Day Yr. (1a)

16 Day of the Week (1b) S ☐1 M ☐2 T ☐3 W ☐4 T ☐5 F ☐6 S ☐7

(1c) A.M. ☐ X P.M. ☐ Y

17 Hour (1c)

18 Have you completed a Mass. driver education course YES ☐ X NO ☐ Y

VEHICLE 1 Name of Operator Making Report	20 Number of Vehicles Involved.	21-26 Date of Birth (2) MO DAY YR.	27 Sex 1 ☐ M 2 ☐ F
Street Address City/Town State		28-29 Driver's License Number and State	
Owners Name and Address (if same, write "same")		Registration Number & State	
Name of Insurance Company only may be written here	Year	Make Type	Approximate Cost to Repair $
Describe Damage to Vehicle:			(3) Parked Car YES ☐ NO ☐
VEHICLE 2 Name of Operator		30-35 Date of Birth (2) MO. DAY YR.	36 Sex 1 ☐ M 2 ☐ F
Street Address City/Town State		37-38 License Number and State	
Owners Name and Address (if same, write "same")		Registration Number & State	
Name of Insurance Company only may be written here	Year	Make Type	Approximate Cost to Repair $
Describe Damage to Vehicle:			(3) Parked Car YES ☐ NO ☐
OTHER Describe Other Property Damage			Approximate Cost to Repair $
Name of Property Owner	Address		

WITNESSES

Other Witnesses or Persons Present	Address	Phone
		Bus. Res.

39 Number Injured. To what hospital was injured taken?

INJURED 1

Name of Injured Street City/Town State

40-1 Age 42 Sex 1 ☐ M. 2 ☐ F.

43 Check if wearing Seat Belt 1 ☐

44 Check if wearing Helmet (4c) 1 ☐

45 Severity (4b)/(5c) Mark First One That Applies: Killed 1 ☐; Visible signs of injury, as bleeding wound, or distorted member; or had to be carried from scene 2 ☐; Other visible injury, as bruises, abrasions, swelling, limping, etc. 3 ☐; No visible injury but complaints of pain or momentary unconsciousness 4 ☐

46 Person Injured (4a)/(5a & 5b)
1 ☐ Operator } In vehicle
2 ☐ Passenger } No ____
3 ☐ Passenger in train, bus, etc.
4 ☐ Operator } On Motorcycle
5 ☐ Passenger }
6 ☐ Pedestrian
7 ☐ Bicyclist
8 ☐ Other

INJURED 2

Name of Injured Street City/Town State

47-8 Age 49 Sex 1 ☐ M. 2 ☐ F

50 Check if wearing Seat Belt 1 ☐

51 Check if wearing Helmet (4c) 1 ☐

52 Severity (4b)/(5c) Mark First One That Applies: Killed 1 ☐; Visible signs of injury, as bleeding wound, or distorted member; or had to be carried from scene 2 ☐; Other visible injury, as bruises, abrasions, swelling, limping, etc. 3 ☐; No visible injury but complaints of pain or momentary unconsciousness 4 ☐

53 Person Injured (4a)/(5a & 5b)
1 ___ Operator } In vehicle
2 ___ Passenger } No ____
3 ___ Passenger in train, bus, etc.
4 ___ Operator } On Motorcycle
5 ___ Passenger }
6 ___ Pedestrian
7 ___ Bicyclist
8 ___ Other

INJURED 3

Name of Injured Street City/Town State

40-1 Age 42 Sex 1 ☐ M 2 ☐ F

43 Check if wearing Seat Belt 1 ☐

44 Check if wearing Helmet (4c) 1

45 Severity (4b)/(5c) Mark First One That Applies: Killed 1 ☐; Visible signs of injury, as bleeding wound, or distorted member; or had to be carried from scene 2 ☐; Other visible injury as bruises, abrasions, swelling, limping, etc. 3 ☐; No visible injury but complaints of pain or momentary unconsciousness 4 ☐

46 Person Injured (4a)/(5a & 5b)
1 ___ Operator } In vehicle
2 ___ Passenger } No ____
3 ___ Passenger in train, bus, etc.
4 ___ Operator } On Motorcycle
5 ___ Passenger }
6 ___ Pedestrian
7 ___ Bicyclist
8 ___ Other

NOTE: Mark all items which apply. The diagram and description of what happened (below) need not be completed if separate 8½ x 11 size sheet with same detailed information is attached. Please sign report in space provided below.

LOCATION

City or Town where Accident Occurred (6a)

Nearest Mile Marker (6b)

Reserved for Registry

Street Name and/or Route Number (6c)

at intersection with ______________ (6d)

or ______ (6e) ______ feet N. ☐ S. ☐ E. ☐ W. ☐ Of nearest intersection, bridge, mile marker, railroad.

Other Landmarks:

Which direction was each vehicle traveling?

Vehicle No. 1 N. ☐ S. ☐ E. ☐ W. ☐

No. 2 N. ☐ S. ☐ E. ☐ W. ☐

54 (6f)

1 ☐ On ramp from route ______

2 ☐ Off ramp from route ______

3 ☐ At rotary

55 (6g)

1 ☐ Area built up

2 ☐ Area not built up

TYPE

56 Accident Involved Collision With:

1 ☐ Pedestrian

2 ☐ Motor Vehicle in Traffic

3 ☐ Motor Vehicle Parked

4 ☐ Railroad train

5 ☐ Ran off roadway hit fixed object ______ feet from road

6 ☒ Bicycle

7 ☐ Overturned in road

8 ☐ Ran off roadway — non-collision

9 ☐ Fixed object on shoulder, sidewalk or island

A ☐ Other

57 If collision involved two or more vehicles mark one of the following:

1 ☐ Rear end 2 ☐ Angle 3 ☐ Head on

SITUATION

What were vehicles doing prior to accident? Mark appropriate box. 58-60

	Vehicle 1	Vehicle 2			Vehicle 1	Vehicle 2			Vehicle 1	Vehicle 2	
1			Making right turn	8			Skidding	F			Parked
2			Making left turn	9			Slowing or stopping	G			Stalled or disabled
3	(7a)	(7b)	Making U turn	A	(7a)	(7b)	Crossing median strip	H	(7a)	(7b)	Stalled or disabled with flasher on
4			Going straight ahead	B			Driverless moving vehicle	J			In process of parking
5			Passing on right	C			Backing	K			Entering or exiting from alley or driveway.
6			Passing on left	D			Starting in traffic	L			Other
7			Stop sign	E			Starting from parked position				

Where was pedestrian located at time of accident? Mark appropriate box. 61

	X			X	
1		At intersection	7		Getting on/off vehicle
2		Within 300 feet of intersection	8		Working on vehicle
3		More than 300 feet from intersection	9		Working in street
4		Walking in street with traffic	A		Playing in street
5		Walking in street against traffic	B		Not in street
6		Standing in street	C		Other

CONDITIONS

62 Light Conditions (8a)

	X	
1		Daylight
2		Dawn or dusk
3		Darkness — road lighted
4		Darkness — road unlighted

63 Traffic Controls (8b)

	X			X	
1		Stop sign	6		Railroad crossing gate
2		Yield sign	7		Railroad automatic signal
3		Warning sign	8		Control device not working
4		Signal light	9		No control present
5		Officer or flagman			

64 Weather Conditions (8c)

	X	
1		Clear
2		Foggy
3		Cloudy
4		Rain
5		Snow
6		Sleet

65 Road Surface (8d)

	X	
1		Dry
2		Wet
3		Snowy
4		Icy
5		Other

76 Road Conditions (8e)

	X	
1		No Defects
2		Holes, ruts, bumps
3		Foreign matter on surface
4		Defective shoulder
5		Road under construction
6		Other

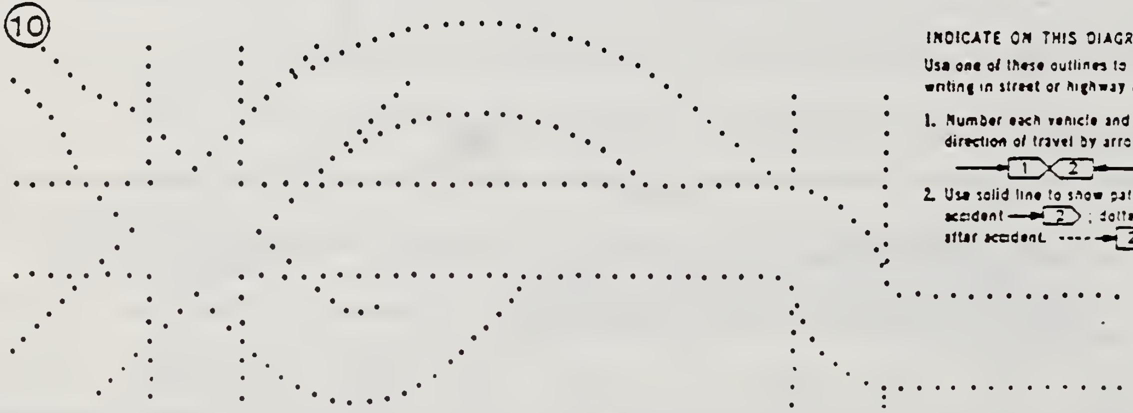
COLLISION CONDITIONS

66 (9)

	X			X			X			X			X	
1		Entered median	4		Hit guard rail	7		Hit signpost	A		Embankment	D		Stone wall
2		Crossed median	5		Hit curbing	8		Hit utility or light pole	B		Ditch	E		Other post
3		Hit median barrier	6		Hit abutment	9		Hit tree	C		Rock ledge	F		Bridge rail

DIAGRAM

(10)



INDICATE ON THIS DIAGRAM WHAT HAPPENED

Use one of these outlines to sketch the scene of your accident, writing in street or highway names or numbers.

1. Number each vehicle and show direction of travel by arrow:
2. Use solid line to show path before accident ; dotted line after accident.
3. Show pedestrian by:
4. Show railroad by:
5. Show distance and direction to landmarks; identify landmarks by name or number.
6. Indicate north by arrow, as:

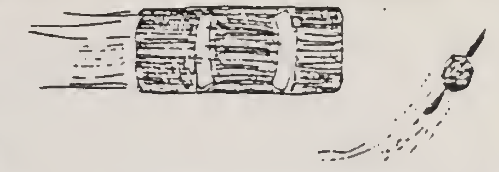
INDICATE NORTH BY ARROW

Describe What Happened: (Refer to Vehicles by Number)

My speed immediately prior to the accident was approximately ______ m.p.h.

Signature of operator making report ______________________ Date ______________

"Crossing" your accident statistics



by John Williams, RSCM

It's been four years since we first received copies of "A Study of Bicycle/Motor Vehicle Accidents: Problems and Countermeasure Approaches," otherwise known as the Cross/Fisher report. It might be putting it too dramatically to say this study transformed the bicycle field. Nevertheless, its impact has been substantial. Many education programs have been revamped to reflect some of the insights from the Cross/Fisher study; many new programs have been developed based squarely on its data. Pamphlets are coming out that discuss the "Cross Types" (the 36 different car/bike collision types identified in the report); film makers tout their wares as "based on the Cross Report."

In the facilities field, the effect is less clear. Some critics use the study to ask pointedly "which of these accident types will your facility designs take care of?" In general, few designers have closely considered the implications of the study. For example, one of the major "physical" problems that the study identified was the sight-distance restriction. Bushes, fences, parked cars, and other obstructions to the view of passing motorists figured significantly in several critical accident types (driveway rideouts, stop sign rideouts). Yet, few bike facility planners have taken this lesson to heart.

In a few progressive communities, police agencies have used the study as a basis for their work in identifying key violations to crack down upon. Most notably, stop sign violations, wrong-way riding, no-lights-at-night, and unexpected turns have been the subjects of attention.

Yet, one question remains—even in those communities that have considered the insights of the Cross/Fisher study. Does the study accurately reflect *local* accident patterns; how much can we generalize?

While one of the strengths of the study was its careful analysis of accidents in four widely-separated communities (Denver, Los Angeles, Detroit, and Miami), we cannot be absolutely sure that our own communities will experience identical problems. Some specialists use this fact as reason enough to discard the study and all its implications. The responsible approach, however, is to look at local accident records to compare and contrast them with the study's findings.

In Missoula, we chose the latter alternative. With very little investment, the City was able to categorize two and one half years worth of bike/car collision reports into Cross/Fisher's classes and types. The initial work was done by a University of Montana student, Mike Calhoun, in the Spring term, 1981. It is now being carried out by the Police Department as a normal function.

Methods

When Mike came to work for me in the Bicycle Program, I gave him a copy of the summary report "Bicycle Safety Education: Facts & Issues"[1], which does an admirable job of distilling the study into its basics. We also talked about accidents; I described how the Cross/Fisher study was conducted and something about the overall accident picture. I explained that, while police reports are important sources of information, they do not represent all bike accidents. They do, however, represent a good sample of the most serious accidents—particularly those involving autos.

We then looked at some examples of reports and tried placing the collisions into the classes and types. Once Mike became familiar with the classification scheme, he had little trouble categorizing the crashes. (His biggest problem was reading the handwriting of some officers!)

We discussed just what information was needed from each report, coming up with a simple list (see figure 1) and he set to work. This phase of the project was the most time-consuming. He had to look up the reports for each accident for the past 2½ years, decifer the information, decide which type of accident had occurred and fill out the form. (Older reports are kept in the basement, and aren't very accessible.) We decided to discard any report that didn't have a diagram showing the collision. Without such a picture, positive classification proved risky. In the end, Mike had classified 91 accidents.

Findings

Figure 2 shows the results and how they compared to Cross/Fisher's findings. While we can't be 100% certain of the statistical reliability of our small study, we do feel it gives a good indication of Missoula's accident problems.

One of the things that struck us most directly was the high median ages for all classes except Class A. Clearly, we have an older cyclist population that many communities, perhaps due to the presence of the University of Montana. It was also a surprise to see that our two biggest types were 9 and 23: motorist's unexpected left turn and motorist's failure to yield at a controlled intersection (stop sign).

The ages of cyclists (figure 3) seem reasonable when considered in light of the accident locations. Many of the collisions took place on major thoroughfares—just where one might expect to find adult cyclists, particularly utility riders.

At this stage, it would be useful to look at *exposure* (i.e. how much bike traffic is on those streets) to determine whether the rate per bike/mile (or per bike/minute) is high. I expect that it isn't, but that we simply have a lot of bike traffic out on those routes. The bike counts we plan for next season will tell us more.

Other findings were interesting as well. Of our 19 night-time accidents, only one involved a cyclist *with* a light. That points to a significant problem in our town, which casual observation easily confirms!

We also found that, according to the police officers' assessments, about one third of the cyclists sustained 'incapacitating injuries.' There was one death. Thus, it seems that a cyclist who gets into a collision with a car is likely to get hurt.

Implications

Since the Missoula program has a strong safety component, we take these results seriously. First, while in the past, I've emphasized the wrong-way riding problem, in the future I'll give more attention to adult riders' difficulties at intersections. One approach will be to produce several tv public service announcements on left-turn conflicts and cross traffic dangers.

Teaching adult cyclists how to deal with traffic will get renewed attention. We've offered courses on *Effective Cycling*, but they've often gone unnoticed by cyclists. In the future, we'll have to work harder to bring people in. Motorist attitudes and behaviors will be difficult to influence but we will have to try by making sure driver training focuses on specific bike/car conflicts and by getting the word out in the media.

Conclusion

Looking at our own accident picture in light of the Cross/Fisher study was a useful exercise. It allowed the Bicycle Program to better focus its efforts on actual problems. It also gave the Program credibility and exposure: newspapers, radio and television are always more impressed if one can say "one third of the accidents were such and such" than if one can only say "I think there are a lot of such and such accidents but don't have any data." BF

Figure 1
Information taken from Police Desk Reports

DR#
Location
Date
Time of Day
Cyclist's Age
Type and Class of Accident
(according to Cross Study)
Citation (if any) and to whom given
Sex of Cyclist
Injury (if any) and Type
Comments

Figure 3
Missoula age categories compared to Cross/Fisher Study

Age of cyclist:	#	%age in category	(Cross/Fisher Study: %ages for non-fatals)
less than 6 yrs.	1	1%	(2.0%)
6-11	12	14	(27.5)
12-15	13	15	(37.1)
16-19	16	18	(13.9)
20-29	35	40	(12.2)
30-44	10	11	(3.8)
45-59	0	0	(1.8)
60+	0	0	(1.7)

References

1. Bicycle Safety Education: Facts & Issues: Dr. Ken Cross; 1978; published by AAA Fdn for Traffic Safety; 8111 Gatehouse Rd, Falls Church, V 22042; single copies available for $0.35.

2. A Study of Bicycle/Motor Vehicle Accident Identification of Problem Types and Counte measure approaches; Dr. Ken Cross and Ga Fisher; 3 volumes; the study from which the abo reference was taken; 1977; may still be availab from NTIS (Springfield, VA 22161); #DOT H 803 317; volumes one and two are very useful.

For more information on accident typing, s page 37.

Figure 2: A comparison of the Missoula accident data with the National Cross/Fisher Study

	Missoula number	Missoula percentage	Cross/Fisher Study: (injuries/fatalities)
Class A: Bicycle ride-out from driveway, alley and other midblock locations. Median age: 9.5 yrs.			
Type 1: residential driveway ride-out	4	4.5%	5.7%/6.7%
Type 2: commercial driveway ride-out	2	2.2	3.2/2.4
Type 3: parallel direction driveway ride-out	0	0	2.5/2.4
Type 4: ride-out over shoulder or curb	2	2.2	2.5/3.6
Total Class A:	8	8.9%	13.9%/15.1%
Class B: Bicycle ride-out at controlled intersection. Median age: 20 yrs.			
Type 5: stop sign or yield sign	6	6.7%	10.2%/7.8%
Type 6: signal phase change; cyclist caught in intersection	2	2.2	3.1/0.6
Type 7: ride-out at signal: multiple threat	1	1.1	2.0/2.4
Total Class B	9	10%	17.0%/12.0%
Class C: Motorist turn/merge/drivethrough/driveout. Median age: 19.5 yrs.			
Type 8: Motorist drive-out from commercial driveway/alley	4	4.4%	5.3%/0%
Type 9: Motorist failure to yield at stop or yield sign	13	14.4	10.2%/1.2%
Type 10: Motorist failure to yield at signal	3	3.3	1.9/0
Type 11: Motorist backing from driveway	0	0	0.8/0
Type 12. Motorist don't even slow for sign or signal	1	1.2	0.5/1.2
Total Class C.	21	23.3%	18.7%/2.4%
Class D: Motorist overtaking/overtaking threat. Median age: 21 yrs			
Type 13. Motorist overtaking, cyclist not seen	4	4.4%	4.0%/24.6%
Type 14. Motorist overtaking/out of control	2	2.2	0.7/4.2
Type 15. Motorist overtaking/counter active evasive action	1	1.1	1.7/2.4
Type 16. Motorist overtaking misjudged space required to pass	[illegible]	[illegible]	[illegible]
Type 17. Motorist overtaking bicyclist's path obstructed	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]
Total Class D	[illegible]		[illegible]
Class E: Bicyclist unexpected turn/swerve. Median age: 14 yrs.			
Type 18: Bicyclist unexpected left turn: parallel paths; same direction	1	1.1%	3.4%/8.4%
Type 19: Bicyclist unexpected left turn: parallel paths; opposite direction	5	5.6	3.2/3.0
Type 20: Bicyclist unexpected swerve left: parallel paths; same direction	0	0	1.5/3.6
Type 21: Wrongway bicyclist turns right: parallel paths	2	2.2	1.1/1.2
Total Class E.	8	8.9%	14.2%/16.2%
Class F: Motorist unexpected turn. Median age: 21 yrs.			
Type 22: Motorist unexpected left turn, parallel paths; same direction	2	2.2%	1.3%/0.6%
Type 23. Motorist unexpected left turn; parallel paths; opposite direction	13	14.5	7.6/0.0
Type 24. Motorist unexpected right turn; parallel paths	3	3.3	3.6/1.8
Total Class F	18	20%	14.3%/2.4%
Class G. Other. Median age: 21 yrs.			
Type 25: Vehicles collide at uncontrolled intersection; orthogonal paths	3	3.3%	2.3%/0.6%
Type 26. Vehicles collide head on, wrong way bicyclist	2	2.2	3.6/2.4
Type 27. Bicyclist overtaking	3	3.3	0.9/0.6
Type 28. Head-on wrong way motorist	0	0	0.6/1.8
Type 29: Parking lot	[illegible]	[illegible]	[illegible]
Type 30: Head-on counteractive evasive action	0	0	0.1/0
Type 31: Bicyclist cuts corner when turning left	0	0	0.0/0.6
Type 32: Bicyclist swings wide when turning right	0	0	0.3/0
Type 33. Motorist cuts corner when turning left	[illegible]	0	[illegible]
Type 34. Motorist swings wide when turning right	[illegible]	[illegible]	[illegible]
Type 35. Motorist drive-out from on-street parking			
[illegible]		[illegible]	[illegible]
Total Class G	[illegible]	[illegible]	[illegible]